Just as real-world pilots new to the Cessna Mustang undergo transition training before flying these light jets, the sim-world pilot will find much about this amazing aircraft to be unfamiliar at first. On the other hand, those familiar with highly-detailed ‘heavy iron’ might find aspects of flying the Mustang to be confusing as well—for example, while the avionics are quite sophisticated, there’s no autothrottle at hand; and Flight Management System (FMS) operation is quite different as well. Keep in mind that the Mustang is designed for single-pilot operation, which is typical of the “very light jet” market’s ‘owner-operator’. Pilot workload is much lighter than is the case with heavier aircraft (the Mustang weighs just 5,350 pounds empty), but on the other hand you’ll likely be on your own in the cockpit. (Two-pilot operations are the norm with Mustangs employed in charter flights, for added safety if medical issues arise.)

So we suggest looking over this guide and doing a few practice flights before flying fellow club member Kurt “Yoda” Kalbfleisch’s companion Tutorial. Here we offer a general orientation to the Mustang’s flight deck and describe some important practices (and good habits) using its highly integrated Garmin G1000 display panels and Garmin’s companion GFC 710 autopilot. You’ll better understand Kurt’s more detailed tutorial once you know your way around the cockpit. By spending some time with both this Guide and Kurt’s Tutorial the Mustang will prove truly immersive and fun to fly!

Overview

Flight1’s Citation Mustang Pilot’s Guide that comes with the product is quite good. In it you’ll find each of the plane’s functions and controls explained. Our goal with this document is to complement Flight1’s guide in two ways:

- Explain how principal automated controls work in conjunction with one-another, and
- Describe when a particular procedure should be used—in other words, what is ‘good practice’?

Before going further we should point out that though we (this paper’s authors) like to consider ourselves flight simulation veterans, for “real-world” information we’ve drawn much of what follows from two excellent, pilot-written publications: Max Trescott’s G1000 Glass Cockpit Handbook and John Dittmer’s GPS Operations on the Garmin G1000 to guide us.

OK, mainly we’re going to concern ourselves (in this paper) with the Primary Flight Display (PFD)—the pilot’s left-hand LCD panel; the Autopilot (its actual name is the “AFCS Controller”) located just below the center glare shield; and (a little later) the MFD Controller which is located on the throttle pedestal between the seats—it’s used to set up and activate our flight plan and, upon arrival, destination approach details. We will, for the time being, ignore operating some of the aircraft systems, such as fuel management, start-up procedures, environmental and some of the PFD/MFD “softkeys,” for example, to simplify and speed up the learning process. As you’ve learned from Flight1’s Pilot’s Guide, there are
additional ‘pop up’ panel elements (such as the throttles, trim wheel, and flap lever, switch panels, etc.) and more views available—not to mention the magnificent 3-D Virtual Cockpit—so you’ll want to be
familiar with those before proceeding. Our purpose here, though, is to understand how the PFD/MFD, AFCS and MFD Controller interact. And to get ready for our tutorial flight later on, we’ll introduce some departure, arrival and approach chart concepts you’ll need in planning and flying the tutorial flight.

Another thing to keep in mind is that the large LCD panel in the center, the **Multi-Function Display (MFD)** provides a visual representation of our flight’s progress—otherwise known as a “moving map.” New information will appear there as our tutorial flight progresses—where we are in our flight plan in particular. That display also shows engine status (to its left) together with fuel indicators, cabin pressurization, and other details as well. Remember also that current tracking information is constantly updated and displayed in the PFD’s navigation status bar. Those “soft keys” along the bottom of both the PFD and MFD displays let us call up specific information on their respective screens—we’ll comment on how these are used in context where appropriate. Taken together the G1000 offers an incredible amount of information, making the Mustang quite easy to fly and navigate as compared with other aircraft types.

**Learning the basics . . .**

So by now you’ve looked over Flight1’s Pilot’s Guide and here we are in front of the Mustang’s G1000 panel. But how to get started? Well, advance the throttles and let’s go fly! Yes, the Mustang is that docile (though you’ll find things happen much faster than you’re used to in say, a twin turboprop <g>). One notch of flaps, rotate at around 85 knots; gear up, flaps up; now let it climb to any desired altitude (for now, but at least 1,000 feet AGL); then level off and reduce thrust to ‘cruise’. Adjust trim if necessary, and remember to hit the pause key whenever you want to study something further. Now let’s take a look around the cockpit . . .

Much about any G1000-equipped plane is intuitive and obvious—Garmin’s engineers took great pains to group and display information intuitively, simply and clearly. But you need to know where to look in specific circumstances and to understand what a particular display is telling you. That’s what we’ll point out in this Guide.

While airborne we’ll do some simple maneuvers to illustrate the main differences from flying with conventional panels. Please bear with us a bit while we cover a few basics—much of this will be “old hat” to many of you (we’ll get to the ‘good stuff’ shortly).

You can’t miss being aware of the principal vertical flight (upper half) of the **Primary Flight Display (PFD)** and horizontal flight indications (in the PFD’s lower half) [see Fig. 1]. This is intentional—there’s no excuse for drifting into a spiral dive while in the clouds by failing to notice that diagonal horizon bar in front of your face—it extends across the entire glass panel! The PFD replaces the familiar six primary “steam gauges”: airspeed, attitude indicator, altimeter, heading indicator, turn coordinator, and vertical speed. Notice particularly the prominent navigation display: its main feature is the now familiar Horizontal Situation Indicator (HSI).
The speed tape (to the left) and altitude tape (to the right) dominate the screen. These will be familiar to anyone flying with a glass cockpit in a commercial or military jet. Notice also the vertical speed indicator just to the right of the altitude tape. A glide slope indicator appears to its left when an ILS locator has been captured (or a GPS-based “WAAS” approach is being flown).

What’s more, information displays are dynamic: you’ll see magenta-colored ‘trend indicator’ lines that tell you how much your speed, altitude, and/or compass heading will change in the next six seconds, based on the aircraft’s current control settings. NAV frequencies are shown (and can be changed) at the PFD’s upper left corner; similarly COM frequencies are dialed in and displayed at the upper right. Between these two are multi-purpose navigation and AFCS (flight mode) status bars, which we’ll discuss as we go along. The important thing is to get into the habit of checking what is displayed there whenever you engage or change a roll or pitch mode command with the autopilot—you may think you’ve selected something (like climbing to a new altitude), but your plane doesn’t know that until the selected command is displayed there. It’s as though you got a verbal “ok” in response to reading a checklist. So keep this in mind—these status bars are definitely your friend!

The next thing of note is the Flight Director (FD). When activated, the FD bars are displayed on the PFD. These consist of a yellow ‘wedge’ and a magenta “airplane” that tell you what control actions to take to manually follow a programmed course. (With a flight plan loaded and activated, the FD’s airplane icon will follow the wedge automatically as you or the autopilot fly the plane.

Now let’s bring up the Autopilot view—again, its formal name is the GFC 710 Automatic Flight Control System (AFCS)—for familiarization [see Fig. 2]. This is a good time for some observations about getting around the sim’s panel views. Until I (Maury) thought about it, I found myself stumbling around trying to access screen views I needed only momentarily. Sometimes the “panel manager” Flight1’s developers had thoughtfully provided was available, sometimes not, depending on the starting point. But once I remembered that one only need click on the air duct ‘hot spot’ to bring up the panel manager, then click ‘autopilot’ icon (or whatever is needed at the moment). Now I could easily find the view I wanted. Really slick. So click on that now.

BTW, you can also memorize <shift>+(number) key combinations, or program these, but I’ve never cared for having to memorize obscure key-presses. For me, a sense of ‘immersion’ comes from looking at the actual control component—a panel view, autopilot knob, FMS keyboard, etc.—and simulating depressing a key, turning a knob, or entering text with a panel keyboard albeit with mouse clicks.

As another aside—you can circumvent calling up panel views and hunting for ‘click spots’ altogether by setting up a secondary touch screen (and using “TouchBuddy” software) with panel overlays representing autopilot and FMS buttons and knobs, and
other functions. The buttons on the touch screen may be assigned button presses that correspond to standard FSX commands, or unused FSX commands that can be linked to buttons on the Mustang’s 3D or 2D panels via a ‘key events file’ that is accessible via “mapping” in the payware version of FSUIPC4. This technique can be applied to GoFlight modules as well. Bill’s done both with excellent results.

Before we do some simple maneuvers, let’s get a little more familiar with the AP’s basic role—keeping the plane in straight and level flight. Turn on the Flight Director by pressing the FD button on the Autopilot, which turns on its adjacent indicator light. If you’re following our example, your plane was trimmed to cruise in level flight; but now we’d like the Autopilot to take over control. Turn on the autopilot by pressing its AP button. Notice that both AP and YD indicators illuminate indicating that both the autopilot and yaw damper are engaged (you must be above 700 feet AGL.) Then press the autopilot’s ALT key and observe the ALT indicator illuminating; the aircraft will be held at the current altitude once stabilized. It is important to point out that experienced pilots will use the Mustangs autopilot extensively, so it is important to learn how to use this tool as it works very nicely with other navigation elements of the G1000 systems.

If you like, go back to your initial take off to make that a little more realistic. Start by turning on the Flight Director; the system will come up in the Pitch Hold and Roll Hold modes. Next set the heading bug left so the heading reference bug is positioned 90 degrees left of your current heading (the selected heading will also appear in the HDG box just to the right of the speed tape). So far your direction remains unchanged, and the AFCS status bar continues to show ‘ROL’ (wings level) mode in green, telling you that the intended action is still pending. Now click the AP’s HDG key. The status display changes to show that ‘HDG’ is now the active mode; the plane banks as a magenta trend line appears on the HSI (the default reflects a standard two-minute turn); the plane levels again at the new heading. As long as the HDG and AP keys remain depressed

1 If you’re familiar with other G1000-equipped aircraft, you’ve probably noticed that they have ALT and HDG knobs on both the PFD and MFD bezels—but these are absent on the Mustang’s panel. Cessna specified that these controls be placed instead on the center pedestal’s MFD Controller, thereby simplifying the panel layout.
Guidelines on Flying the Flight1 Mustang

(t heir white LEDs remain lit) you can command changes in the plane’s direction simply by “turning” the autopilot’s Heading knob. For example, this would be a convenient way to respond to ATC vector instructions while descending toward your Initial Approach Fix.

Climbs and descents are handled similarly, but these come in two flavors: VS (Vertical Speed, for constant climb/descent rate) and FLC (Flight Level Change mode, for changing altitude while maintaining a constant airspeed). Under most circumstances it’s best to climb in FLC pitch mode; descents are best handled in VS mode. The procedure in either case (while in level flight) is to first preselect an altitude using the ALT SEL knob, before selecting either the VS or FLC pitch mode. Confirm that the altitude dialed in appears in the PFD just above the altitude tape.

For VS mode (remember to confirm that ‘VS’ appears in green on the PFD’s AFCS status bar) you’ll also “move”\(^2\) the VS wheel—click at its top ‘-’ to select a particular descend rate in feet per minute) or at its bottom ‘+’ to climb, while again watching the AFCS status bar until you see the desired climb/descent rate displayed in green. The actual rate-of-climb/descent will appear in the vertical speed indicator alongside the altitude tape. Notice that ‘ALTS’ appears on the status bar too, but for now it’s in white, meaning that the selected altitude has been “armed.” That too will change to green once the plane is within 200 feet of the assigned altitude; the plane levels off and then holds the new altitude.

\(^2\) Remember that you can rotate your mouse center wheel instead of using mouse clicks wherever reference is made to “turning” one or another knob. You’ll often find this method is much easier to do quickly.
Quoting from Max Trescott’s Handbook, “The Vertical Speed mode is useful for maintaining a climb or a descent at a constant rate in feet per minute. My personal preference is to use this mode for descents and to use the FLC mode for climbs.” He adds this caution: “Always check the vertical speed soon after you engage the autopilot. If it captures an unrealistically high climb rate, the autopilot can pull the airplane into a stall.”

Commanding the FLC mode follows a similar procedure: As before, use the ALT SEL knob to select and confirm the desired altitude. Then press the FLC key. The system will acquire the aircraft’s present speed and a FLC annunciator appears in green in the status bar’s active pitch mode field [as illustrated on the previous page]. To initiate the altitude change you also need to change the engine power—add power for a climb, reduce the throttles to idle to descend.

Again quoting Max Trescott, “FLC is particularly useful in a climb, as it allows you to maintain a target climb airspeed, such as Vy, the best rate of climb, even as aircraft performance decreases.”

Well, there you have it. There’s a third, more sophisticated pitch mode available in the actual Mustang; that’s shown as the autopilot’s (inactive) VNV button (for “Vertical Navigation or VNAV”). This VNAV mode couples the autopilot with waypoint altitudes specified in the flight plan; however Flight1 hasn’t implemented VNAV functionality.

Another thing to keep in mind regarding the autopilot is to observe certain operating limits: Don’t engage the AP until the aircraft is at least 700 feet AGL; always disengage it before descending below 800 feet in VFR flight (200 feet for an ILS or WAAS approach).

Let’s fly a route . . .

Now that you’re comfortable with the autopilot’s basic functions let’s really put it to work; we’ll use it in conjunction with the MFD Controller and MFD screen itself to set up and fly a selected route between origin and destination airports. Though a simple flight plan can be created and loaded using FSX itself, we’ll get a more complete (and far more realistic) plan by using our Mustang’s FMS (Flight Management System) instead. In many ways the Mustang’s is as good as that found in a Boeing or Airbus FMS. Here’s some more good news: the knob twisting needed to enter airport, VOR and other waypoint data in earlier Garmin GPS’s—such as the GNS 430 / GNS 530 familiar to many GA pilots—has been minimized by providing a keypad on the MFD Controller (though you still have the option of using the PFD’s knobs to enter those).

So what we have in mind is to include published departure and arrival waypoints, ultimately selecting our destination airport’s published approach (corresponding to the runway selected upon arrival, which

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3 While many FMS functions described below can also be accomplished in flight more conveniently by using the duplicate FMS knobs and keys on the PFD’s right bezel, we’ll explain FMS operations using the MFD Controller.
in turn depends on wind direction at that time and other factors). While seemingly complex, the technique involved is surprisingly simple. In a nutshell, you take the following steps to set up an IFR flight plan:

1) Enter the departure airport ICAO code, enroute VOR names, and your destination airport ICAO.
2) Select and enter a suitable DP (Departure Procedure, aka SID) for the intended takeoff runway; the FMS will fill in the waypoint details for you, based on the transition waypoint you select.
3) Select and enter a suitable STAR (Standard Terminal Arrival) corresponding to the intended destination airport; waypoints are selected for you as above. [Typically the departure and destination transition waypoints will be the beginning and ending enroute VORs from step #1 above].
4) Select and load (or activate) a named approach to the desired runway. Again, the required fixes (including Go-Around direction and hold points) are selected automatically from the GPS’s database.

In real-life flying you’d likely perform the first two steps as part of your pre-flight; but you’d wait until nearing your destination—and after either contacting an arrival controller, or obtaining ATIS information—to set up your arrival, step #3. Similarly you’d perform step #4 when instructed (or deciding) to land at a specific runway. There are many variations on this theme, not the least of which is to choose Direct-to navigation for parts or for the entire journey, particularly under VFR conditions—that too is managed by the FMS. In many instances there will be a choice of approach procedures—either ILS, or by WAAS (which uses GPS-based direction vector and glide path inputs rather than the airport’s locator beacon).

And you might follow ATC-issued vectors instead for part or all of the approach. The variations are seemingly endless—you can consult aviation publications for specifics, particularly either Max Trescott’s G1000 Guide or his more detailed GPS and WAAS Instrument Flying Handbook. But for our purposes here, what follows will get you on your way.

When you’re ready to fly Kurt’s KSAN–KJSC tutorial you’ll be referencing the respective airport’s DP, STAR and IAP charts, San Diego’s “PEBLE TWO DEPARTURE” and San Jose’s “ROBIE TWO ARRIVAL.” A couple of good source (i.e., free) in the U.S. for these charts is www.airnav.com, or the FAA’s “Terminal Procedure Publication” at http://naco.faa.gov/index.asp?xml=naco/online/d_tpp; click on the link under “Product” to reach the actual search page, currently at http://naco.faa.gov/digital_tpp.asp?ver=1001&eff=01-14-2010&end=02-11-2010. And likely you’d look up FAA-authorized flight plans to select a route—either ‘low altitude’ V-routes or ‘high altitude’ (in the U.S. 18,000 feet and above) J-routes.

For route planning I prefer Ernie Alston’s FSBuild, which includes considerable useful information beyond the intended flight’s waypoints. For example, here’s the flight plan you’ll find in Kurt’s tutorial: “PEBLE3.SXC VTU RZS.ROBIE2”. PEBLE3 designates our DP, while SXC is the DP’s transition waypoint Kurt chose for this flight. Similarly, ROBIE2 is our STAR and RZS is our route’s terminating waypoint. VTU
(and any successive fixes, likely present with longer flights) is a VOR crossed during the flight’s cruise phase. By the way, those waypoint names are abbreviations for Santa Catalina, Ventura, and San Marcus, California respectively. We’ll be using the RNAV (GPS) WAAS Approach to runway 29, so get that chart too.

So the steps to create our flight plan are to:

1) Enter KSAN, VTU, and KSJC
2) Select the PEBLE3.SXC departure

3) Select the ROBIE2 arrival

We’ll see that Gilroy is our flight’s terminating waypoint; from there we’ll select the final step:

4) Load the RNAV (GPS) RWY 29 approach

Looking at the flight planning process in outline form as we have here clears up, we hope, what otherwise would seem something of a mystery. Kurt walks you through this step-by-step; here we’ll point out how the Mustang’s flight plan entry process works in general terms, and point out a few things as to how the FMS interacts with the autopilot, PFD and MFD.
FMS operation concepts

As Cessna’s Citation Mustang Operating Manual puts it, the FMS provides for flight navigation planning and enroute status monitoring. The flight plan may be used to guide the flight by the:

- Pilot viewing the FPL and MAP pages for general reference
- Pilot using the FD to follow the flight plan
- Aircraft using the AP to follow the flight plan.

The FMS operates through the MFD’s flight plan pages, which allows the pilot to enter a flight plan with an entire flight profile, from takeoff to landing, as we’ve seen. While the actual Mustang’s FMS supports both lateral and vertical navigation (typically altitude/speed settings or restrictions), as the Flight1 Mustang doesn’t implement the actual plane’s VNAV function, it also does not provide a means to enter altitudes into the flight plan, or to automatically compute top-of-climb (TOC) or top-of-descent (TOD) intercepts. Also note that the Flight1 Mustang doesn’t implement the MFD Controller ‘Store Flight Plan” menu key; you’ll have to re-enter that route for future flights.

The MFD/FMS controller provides primary control of these functions [see Fig. 3]. The PFD may also be set to display smaller windows containing FMS information and maps. As noted, corresponding controls on the PFD bezels may be used to control the FMS.

Flight plans and their associated map and information pages are normally presented on the MFD. In the actual Mustang the FPL (flight plan) page group includes two types of pages:

- ACTIVE FLIGHT PLAN—Flight plan currently active in the G1000, including VNAV
- FLIGHT PLAN CATALOG—List of all flight plans stored in the G1000

Courses and waypoints in an active flight plan are depicted on the MAP–NAVIGATION MAP page (and other maps) of the MFD. The course for the active leg of an active flight plan is displayed as a magenta line. Other legs of the course display as white lines. In the actual Mustang both FPL pages may be viewed on the MFD; but on our Flight1 Mustang the “Flight Plan Catalog” page isn’t implemented. Since flight plans cannot be stored in this implementation, the ‘Flight Plan Catalog’ function is not present.

Here’s a general rundown on using the MFD Controller: (as seen in Fig. 3 on p. 2) the MFD Controller is comprised of an ‘FMS knob’, four function keys – D (the direct-to key), FPL, MENU, and PROC; and a data entry keyboard. The other essential key is ENT (for Enter), located in the lower group. The RANGE knob is used mainly to change the MFD’s map scale.

These are the main points to remember when creating a flight plan—

a) Click FPL to start a new plan
b) Activate the cursor by pressing the FMS knob
c) Click the FMS inner knob’s 5 o’clock position (“twist right”) to open the Waypoint information page -- remember to do this for each waypoint to be entered.
d) Enter the waypoint name (click keyboard letters, or use your computer’s keyboard with scroll-lock on); then press ENT.

e) Repeat steps c) and d) for each waypoint to be entered.

f) Activate the flight plan. Click the FMS outer knob to move the cursor up to the waypoint directly below the starting point, then press the MENU key and select the Activate Leg option. Your flight plan course will now be displayed in magenta on the MFD and the Flight Planning page will display the waypoints and distances along your flight plan.

g) Press the FPL key to close the Flight Planning page. The first leg of the flight plan will be displayed in the PFD’s navigation status bar.

The method to add a DP (SID) and/or STAR is quite simple—you start with the PROC key, which opens the procedures menu, then use the outer FMS knob to scroll to ‘Select Departure’ or ‘Select Arrival’ as the case may be, and press ENT; now scroll and select the desired DP/STAR name and transition details, pressing ENT to record each selection. Press ENT a second time to add the procedure’s waypoints to the flight plan. Approaches also are selected by this method, with an additional option to Load or Activate the selected approach.

Figure 4. MFD view with Flight Plan page displayed (DP has been entered during pre-flight).
FMS operational details are covered in further detail in the companion Tutorial.

**GPS navigation**

With the G1000 you have a choice of conventional **VOR to VOR navigation**, electing either a visual landing approach or (if the intended runway is ILS equipped) an instrument approach—or **GPS-based navigation**, including GPS-guided landings at WAAS equipped runways. Our tutorial flight uses the latter, but could as well have been flown with the first option.

An active flight plan controls the plane’s course once you do two things: (1) Click the PFD’s CDI soft key until the HSI’s ‘D’ bar (deflection line) appears in magenta (the alternative settings are VOR1 and VOR2, (green) which follow their respective tuned navigation frequencies); and (2) Click the NAV switch on the AP. The current (active) course leg appears in the PFD’s navigation status bar and on the MFD’s moving map. See how it all fits together?

![Figure 5. GPS descent in Approach mode. Note that altitude is above magenta Glidescope Indicator, indicating a late or too-shallow VS descent setting.](image)

You could as well fly using a hybrid of GPS-based navigation up to the Initial Approach Fix (IAF), then switch to ILS-based navigation (where available) for the landing. In other words, you would switch from GPS waypoints (defined in the active flight plan) once you’ve passed the STAR’s final waypoint, switching over to the selected runway’s ILS frequency for landing. To do this, tune the runway ILS frequency...
(NAV1) and click the PFD’s CDI soft-key to select VOR1—that deselects GPS guidance and couples the autopilot to our radio-based navigation mode.4

Having crossed the STAR’s last waypoint click the AP APR button. The autopilot will turn the aircraft from its current heading to a track that intercepts the approach course. The G1000 system senses when the ILS glide slope has been captured and, timed to align with the runway centerline, turns the aircraft to track the approach course. The GPS or ILS track—the intersection-defined waypoints along the extended runway centerline—is followed and displayed on the PFD and MFD down to the Final Approach Fix (FAF). Remember that you are hand flying the landing—it’s still up to you to manage the aircraft’s power setting and speed to track the glide slope—and be sure to disengage the AP before descending through 200 feet (as this is an instrument landing; or 800 feet for visual landings). As you decelerate set the flaps for landing and lower the gear at appropriate speeds, then flare as you settle on the runway.

Using the G1000’s database, additional MFD pages are available that call up reference data listing navigation aids, airports and runways with their radio frequencies and other related information. There’s more on this in Kurt Kalbfleisch’s Tutorial. So let’s go over there and see what Kurt has to say!

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4 With Flight1’s Mustang version 1.02b the FMS loads the Nav frequency and switches the CDI to the NAV source. The FMS tunes the VOR1 radio for you when you select an LOC- or ILS-based approach. On an approach that does not have a GPS overlay, the FMS also auto-switches the CDI’s GPS / Nav1 mode once the leg to the IAF is active. On a LOC frequency, it will automatically set the inbound course.